Research and Alaskan Agriculture 1950-51
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UNIVERSITY OF ALASKA
AGRICULTURAL EXPERIMENT STATION
PALMER, ALASKA
DON L. IRWIN, DIRECTOR
IN COOPERATION WITH THE
UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
Agriculture is Alaska's most rapidly expanding industry. Recent figures released by the Alaska Development Board show that Alaska's farm products increased in value from $460,000 in 1939 to an estimated $3,000,000 in 1948. Additional increases have occurred since 1948. In a measure, the value of these increases in edible products has been offset by a corresponding decline in fur production caused by curtailment of cheap salmonfeed, sagging fur markets, changing demand in styles, mediocre breeding stock on which many fur enterprises depended, and importation of skins from Russia. Census figures show that the number of fur farms dropped from 164 in 1939 to 9 in 1950. In 1939 there were 459 farms in Alaska, excluding fur enterprises. By 1950 there were 516 farms and more were being developed.

Alaska's agricultural economy has increased in stature in the last decade. This increase has been accomplished by individuals and families who have strenuously hewed their existence from virgin forests at a tremendous sacrifice of living standards and other cultural refinements. They have been compensated in part by a greater freedom. Their efforts have been rewarded by high prices. Alaska's future cannot however, rest secure on price differentials and the enterprising spirit of a few hardy pioneers. To compete with more favorably located agricultural areas, efficient farm communities must become established. Alaska's farmers must adapt their techniques, their crops and their livestock to the environment in which they live and produce. This task is beyond the capabilities of individual farmers. Research and promotion properly should be conducted here, as in other countries, by specialists supported and subsidized by those who benefit from this work. Alaska's Agricultural Experiment Station has been organized to assume this task. The objectives of this organization are to increase production and lower unit costs to the end that Alaska's future may rest firmly on a stable agricultural industry, supplementing other features of an unlimited economy.

The Experiment Station program has developed and improved during these 2 years. By the close of the growing season of 1951, 8 departments were participating in the research program. These included 23 technical researchers engaged in full time activities, supplemented by a labor and administrative staff of 36 full and part-time employees. Substantial progress has been made in coordinating all agricultural studies in accordance with the Memorandum of Understanding jointly sponsored by the University of Alaska, the Agricultural Research Administration and the Office of Experiment Stations. Alaska's agricultural research program has now reached about 60 percent of the level envisioned by Congress when reorganization was started in 1947. Continued Congressional and Territorial support is anticipated. In line with plans conceived during the initial phases of reorganization, increases in direct Federal appropriations, together with increases in land-grant monies and Territorial matching funds will encourage full fruition of this program by 1955. By that time the Alaska Experiment Station will be fairly well equipped, housed and manned. Thereafter, a greater proportion of effort will be devoted to pure and applied research.
An extensive building and rehabilitation program continues. Heating facilities at the Fairbanks Station were largely completed. A garage-threshing shed was constructed and other potential work space improved so that it can now be efficiently used. A new 5-inch well was driven to a depth of 102 feet. A new 3-phase power line was built to insure a continuous and reliable electrical supply. Work was begun on a concrete garage and workshop. Still pending are needed barn repairs, housing for at least one family, and a minimum of leveling and landscaping to improve drainage and living conditions. An abandoned root cellar under the barn was rehabilitated to provide storage space for 2,000 bushels of grain raised and dried on the Station in 1951. One residence was insulated and repaired. The fencing program, graveling service areas and filling low places around buildings was continued.

At the Matanuska Station, construction of a seed and processing building was continued; this structure will house central heating equipment for controlled forage and grain drying when completed in 1952. As at Fairbanks, necessary barn repairs have been postponed, awaiting favorable action by Territorial control agencies. Maintenance and repair of living and working quarters improved morale and efficiency. The Palmer building program has reached its maximum effort with the completion of 7 residences, occupation of the new office-laboratory, and partial construction of greenhouse and cold storage facilities. At Petersburg, the old well was repaired and some repairs were put on the dwelling. A 7-stall garage and storage shed was completed but remains unpainted.

Research results for the past 2 years are summarized in the following pages. In presenting this material much data has been condensed. Some of the information was included in reports either already published or being printed. Additional reports to appear as bulletins or circulars are in preparation.

The attached report was prepared by a committee consisting of Dr. A. H. Mick, Soil Scientist and Dean, Dr. Charles E. Logsdon, Plant Pathologist, and Hugh A. Johnson, Economist and Station Editor.

[Signature]
Director
Agronomic research in Alaska is directed toward finding means by which the farmer can produce more feed at home. New varieties of forage and cereal crops better adapted to our sub-arctic environment are being bred. These, when employed together with the best cultural methods provide a means of increasing yields per acre by substantial amounts. Control of weeds also would increase yields through removing the competition for moisture and fertility. Increased yields of pasture, hay and grain mean more independence with regard to livestock feed and this should result in higher net income.

Forage Crops

Breeding If a winterhardy legume were available to Alaska farmers, it would be of immense value because the high protein roughage resulting would make it possible for farmers to complete livestock rations with homegrown grain mixtures. Only one legume, yellow-flowered alfalfa, possesses sufficient hardiness to survive Alaskan winters consistently, but unfortunately it is lacking in several important characteristics. Of promise, though not yet sufficiently tested, is a selection of red clover believed to have come from Russia which has been growing at the Fairbanks Station for a number of years. All other introduced varieties of forage legumes winterkill completely in the Matanuska area and partially in the Fairbanks area. More favorable winter snow cover in the latter area accounts for the better survival even though air temperatures are lower.

Crosses have been made between the hardy yellow-flowered alfalfa and purple-flowered alfalfa and in 1951 some 2,200 plants arising from these crosses were set in the field. It is hoped that the hardiness of the former alfalfa can be combined with the forage qualities of the latter. Selections are being made within the yellow-flowered species and in progenies from plants of variegated alfalfa that survived several winters in Fairbanks. Tests were begun to evaluate these selections.

Studies were begun on sweetclover, primarily for utilization as an annual silage crop. When drilled in rows 18 inches apart, even biennial varieties make a phenomenal growth as a response to long days and green weight yields ranging from 10 to 14 tons were recorded. Some varieties reach a height of 4 to 5 feet in the 4 months from seeding in mid-May to harvest in mid-September.

Although bromegrass, timothy, and Kentucky bluegrass are regarded as sufficiently winterhardy, tests were begun to learn which strains of these grasses are best suited to Alaska for use as pasture and hay. Bromegrass appears to be outstanding among the grasses, but timothy may be of special value in short rotations. Breeding nurseries of several thousand spaced plants of these grasses were established in 1951.
Culture Fertilizer trails on bromegrass revealed very substantial increases in yield resulting from applications of nitrogen and phosphate. In the case of nitrogen, yields were in direct proportion to the amount of nitrogent applied. In the dry year of 1950, rates of nitrogen of 200 to 400 pounds per acre failed to increase yields above the 100-pound rate because of moisture shortage. In 1951, plots fertilized heavily with nitrogen in 1950 showed increased growth indicating a carryover of nitrogen from one year to the next. Rates of available phosphate in excess of about 80 pounds per acre do not appear profitable on bromegrass. Results indicate that nitrogen and phosphate should be applied in combination on bromegrass. Either applied by itself has very little effect.

On native "hayflats" (tidelands covered mostly by species of Carex) only nitrogen produced any increase in yield.

Date of cutting studies on bromegrass for hay indicated that the best combination of yield and protein content occurred at the time the panicles were about half unfolded. Yields increased some with later cutting, but protein content diminished rapidly.

Studies begun in 1951 showed that for silage production an oat-pea mixture of about 40 pounds of oats and 60 of peas gave highest yields of the 4 mixtures tested. Cutting at the time when oats were in the milk stage and the lower pea pods well filled resulted in as high dry matter yields as later cutting and in addition resulted in silage with a higher protein content. The rule in growing oats-and-peas for silage is: more peas, cut early equals more protein.

Cereal Crops

Breeding Barley is the best adapted cereal of those that can be grown in Alaska. It can be depended on to mature every year in the Matanuska and Tanana Valleys and is the earliest of all cereals on the Kenai Peninsula, though it does not mature every year there. It yields more pounds of grain per acre than either oats or wheat. From variety testing work performed, it became evident that Edda barley, a Swedish variety, was much superior to the commonly grown Trapmar and in 1951 this variety was released to Alaska farmers. It is outstanding in yielding ability and resistance to lodging, but has very rough awns, a character disliked by some farmers. Trapmar is a low yielder, lodges badly and is very susceptible to smuts, but it has no awns and it is hulless, two characters favored by some growers. In an attempt to locate still better varieties and to isolate varieties with special characters, the World Collection of 5,215 varieties was grown at Matanuska in 1950 and the best varieties (368) were saved for further testing.

Oats are the second best adapted cereal crop for Alaska. Some varieties are very early but low yielding, while others produce very high yields but are so late that they do not mature every year. The best combination of maturity and yield were found in the variety Golden Rain (originally from Sweden) which was made available to Alaska farmers in 1951. The commonly grown varieties, Victory and Swedish Select, are quite similar to Golden Rain in yield but are a little later. Because Golden Rain is not a perfect variety, the World Collection of 3,875 oat varieties was grown in 1951 in the hope of finding better varieties and/or good breeding
material. From the Collection, 320 were saved for further study. Crosses were made between some early and late varieties and should result in better varieties in future years.

Wheat is the least well adapted of all 3 spring cereals and only a limited number of wheat varieties are sufficiently early to mature every year. The good quality bread wheats from the States and Canada are too late maturing for use in Alaska. Khogot, of Siberian origin has been the most reliable variety from the standpoint of both yield and maturity. It lodges badly and shatters seed easily, however. A number of wheat selections are now being tested and one of these probably will replace Khogot in a few years.

Several miscellaneous crops, namely flax, buckwheat and millet, were evaluated to some extent. Millet was found to be of no value in Alaska. Buckwheat makes a very good growth but utilization is very limited except possibly for poultry feed. Flax produced good yields of good quality seed. However, its maturity is such that it may get caught by frost in some years and it lacks ability to cope with even moderate weed competition. Early varieties were sought in the World Collection of 668 varieties grown in 1951.

**Culture** Date of seeding experiments conducted over the past 3 years indicate that barley, oats, and wheat should be seeded in the first half of May to insure maturity and good yield. Rate of seeding studies revealed that all 3 cereals should be seeded at about 100 pounds per acre. Fertilizer studies have resulted in a general recommendation that 20 pounds of nitrogen and 40 pounds of phosphate be applied just before or at the time of seeding.

**Weed Control**

A number of chemicals were used as pre-emergence and post-emergence sprays on forage and cereal crops in an attempt to find treatments which can be used to reduce the severe competition afforded to these crops by weeds. Dinitro compounds proved to be most effective in post-emergence weed control in forages, cereals and oat-pea mixtures. The use of 2,4-D is not recommended because it is not effective at low rates on several important weeds and higher rates often result in severe injury to the growing crops. Some chemicals are promising for pre-emergence spraying, but more work is required before they can be recommended to farmers. It has been determined that quackgrass can be eradicated with 50 pounds of TCA per acre. It usually is dissolved in water and applied as a spray. Treatment generally should follow plowing and diskng. If applied early in the season and moisture conditions are favorable, a cover crop can be established before winter as a protection against wind erosion.

**ANIMAL INDUSTRY**

A stable dairy industry depends on the development and maintenance of herds that can produce large amounts of milk. A breeding research program provides superior germ plasm which is available to all herds through artificial insemination. Improved methods of feeding dairy calves encourages the raising of all herd replacements on the farm rather than importing them. Better methods of harvesting and storing forage reduce production costs.
Research in this field has reached its maximum level without additional investments in livestock, building, and personnel. It is planned to continue work on problems now underway until definite solutions have been derived. Other pressing questions will then be attacked with major emphasis on the dairy industry.

**Dairy Breeding**

Nearly 2,000 cows have been bred artificially since our program was begun in 1948. A few heifers from these breedings now have been milking 10 months. Most of them show promise of being better than their dams.

The rate of conception has gone up as farmers have become more familiar with the program. Non-returns were 66 percent during 5 months in 1951. June has consistently been a month of low conception.

**Dairy Feeding**

**Raising Dairy Calves** Herd replacements can be raised efficiently on farms. As a necessary supplement to the breeding program more calves are being raised on Alaska's dairy farms than ever before. Since the cost of raising calves is in direct proportion to the amount of whole milk in their ration, efforts have been directed at finding a satisfactory whole milk substitute.

Nine calves raised on Calf Meal* made average daily gains of 1.27 pounds per calf. Their feeding cost to 6 months of age was $56.95 per calf. Ten calves were raised on Calf Manna* with average daily gains of 1.39 pounds at a cost to 6 months of age of $61.35 per calf. Eight other calves were raised on skim milk powder. Their average daily gain was 1.38 pounds and the cost to 6 months was $44.34 per calf. All 3 rations were satisfactory but skim milk powder was the cheapest because calves can be changed directly from colostrum milk to skim milk without feeding any salable whole milk. These costs were much less than the values of animals for beef at 6 months of age. Both steer and heifer calves continue to be in great demand.

Powdered skim milk has become harder to obtain. Therefore, rations containing milk substitutes must be developed. Seven Guernsey calves were raised to 60 days on skim milk powder plus Alaskan grains and soybean meal. Seven more were raised to 60 days on skim milk powder plus commercial dairy ration. There were no differences in rate of growth. The first gained at the rate of 1.18 pounds per day and the latter at 1.15 pounds per day up to 6 months of age. Calves will grow just as well on Alaskan grown grains as on grains shipped in from the States.

Seven Holstein calves were raised on whole milk to 45 days and Alaskan grains. Seven more were raised to 60 days on skim milk powder and a commercial dairy ration. The first group had a daily gain of 1.33 pounds and the second 1.39 pounds per day. The group on skim milk powder gained just as fast as those that were fed whole milk for a longer period. It cost about $20.00 less to raise calves to 6 months of age on powdered skim milk than when whole milk was fed.

* Calf Meal and Calf Manna are commercial calf feeds.
Feeding Silage Field-cured hay is the most expensive of the 3 methods of harvesting and preserving forages. In addition, it results in the lowest quality feed. Barn-dried hay has been intermediate in quality of roughage and about as expensive as field-cured hay, while silage has been the highest in quality and the cheapest to harvest and store. From a survey of dairy farmer records in the Matanuska Valley, it has been shown that average milk production per cow has risen from 7,200 pounds in 1947 to 8,300 pounds in 1950. This closely parallels the increased use of forages for silage.

A pound of dry matter in silage on the average is about 44 percent more efficient than a pound of dry matter in field-cured hay, the value of barn-dried hay being intermediate. Average harvesting costs per ton of dry matter were: field-cured hay, $28.43; barn dried hay, $28.56; silage $18.05. Average dry matter losses from cutting to storage were 41.1, 28.6, and 21.0 percent for field-cured hay, barn-dried hay, and silage, respectively. Reduced costs, lower dry matter losses, and a higher quality feed result from utilization of forages as silage.

When bromegrass harvested in 1949 was fed to milking Guernsey cows, a pound of dry matter in silage and barn-dried hay was 33 and 13 percent more efficient, respectively, than a pound of dry matter in field-cured hay. Oat-pea forage harvested in 1949 gave similar responses when fed to heifers.

Oat-pea and bromegrass silage are about equal in feed value. Acre yields of these two forages are also about equal when both bromegrass cuttings are included in the comparison. Advantages of bromegrass over oat-pea forage are:

1. A first cutting of bromegrass can be field-cured as hay in late June when weather conditions are usually favorable. Oat-pea forage is not ready to cut before the first of August at the earliest when wet weather usually prevents satisfactory field-curing of hay.

2. Bromegrass is a perennial crop. After a good stand has been established, further tillage and seeding costs are avoided. These savings more than offset the costs of two seasonal harvests.


4. A second cutting of bromegrass supplies an economical and nutritious silage.

Preserving forage as silage offers several distinct advantages, despite the large amounts of green matter that must be handled:

1. Silage can be harvested and processed in wet weather.

2. It is the most efficient method of preserving feed since it produces more milk per pound of dry matter and therefore more milk per acre.

3. Labor requirements and costs per ton of dry matter are less than for hay. This is especially true where modern choppers and unloading machinery can be used.

Pasture Management Previous work has shown that pasture yields in the year of renovation exceed those of check pastures and that yields continue to increase during the next 2 seasons even
though legume stands winterkill during the first winter. The third in a series of four pastures was renovated in 1950 by disking and reseeding to bromegrass and white and alsike clover (the first, second and third pastures were renovated in 1948, 1949 and 1950). No renovation was made in 1951.

Yields on all four pastures in this series were measured in terms of standard cow days, using milking Guernseys. Average and relative yields are as shown in the following table:

<table>
<thead>
<tr>
<th>Standard cow days per acre</th>
<th>Relative yields</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1950</td>
</tr>
<tr>
<td>No treatment</td>
<td>46</td>
</tr>
<tr>
<td>First year renovated</td>
<td>51</td>
</tr>
<tr>
<td>Year after renovation</td>
<td>63</td>
</tr>
<tr>
<td>Second year after renovation</td>
<td>63</td>
</tr>
<tr>
<td>Second year after renovation</td>
<td>70</td>
</tr>
<tr>
<td>Third year after renovation</td>
<td>—</td>
</tr>
</tbody>
</table>

Yields the third year after renovation declined to about equal the check while in the second year yields were about 50 percent greater. The low yield of the first year probably was a result of extremely dry weather in the year of renovation and in the spring of the first year following. At Fairbanks where the renovated pastures are on a droughty hillside, renovation has shown no increase in pasture yields.

In a second series of pastures, Kentucky bluegrass, red fescue, renovated bromegrass, and unrenovated bromegrass were compared. Except for 200 pounds of 7-21-15 fertilizer per acre applied to the renovated bromegrass plot, this series remained unfertilized. Kentucky bluegrass consistently outyielded red fescue by 9 standard cow days per acre per year and unrenovated bromegrass by 15 standard cow days. Renovated bromegrass exceeded Kentucky bluegrass in the second year after renovation but previously was inferior. While renovation alone increases pasture yields, all indications are that fertilization, especially with nitrogen or a combination of renovation and nitrogen fertilization, will produce greater increases.

Steer Feeding Steers overwintered under a straw-covered pole shelter were fed all the stack silage they would eat from November 1 to June 1. They were pastured on woods pasture after June 1. Total cost, without labor or pasture, was $108 per steer including the first 6 months when they were raised as other dairy calves. The value of these steers dressed was $200 per steer at the average age of 1 year 7 months.

Their average age was 7½ months on November 1 and their average weight 397 pounds. The average weight on June 1 was 483 pounds. The average gain during the winter was only 0.41 pounds per day but otherwise they came through the winter in good shape. These steers had an average weight of 702 pounds on September 1, with an average daily gain on woods pasture of 2.38 pounds.

During the winter of 1950-51 seven steers were handled in the same manner. Their average age on November 1 was 8 months 10 days, their weight 419 pounds. On June 1 their weight was 468 pounds. The average daily gain during the winter was 0.23 pounds.
Their weight on September 1 was 587 pounds with an average daily gain on pasture of 1.29 pounds. The pasture season of 1951 was extremely dry so that pasture was not as plentiful as the year before which accounts for the lower gain in 1951 as compared with 1950.

**Supplemental Light**

Cows going into the winter with gradual shortening of days produce as well as cows provided extra light. However, if the hours of light are lessened abruptly, milk production falls off rapidly. Increases in the number of heat periods in cows and in conception rates while exposed to artificial lights also were observed.

Heifers definitely have more heat periods when supplied extra light. Six heifers over a year of age were divided into 2 groups, one supplied with extra light the other without. The groups were changed on December 21, the shortest day. Both groups were watched very carefully. The 6 heifers did not miss a single heat period when supplied with extra light although they missed 4 heat periods while not supplied with extra light.

A limited amount of supplemental light stimulates egg production in laying hens during their first winter, the most beneficial "day" length being 12 hours. In their second year of production 12 and 14 hours of light proved no better than 10 hours for this particular flock.

**Poultry Feeding**

Self-fed pullets grew as well as hand-fed birds on test. Pullets also grew as well on 18 percent protein mash as on 26 or 32 percent mash. Egg production was lowest in pens receiving the 32 percent protein mash.

Egg production over an 8-month period on various rations was as follows:

<table>
<thead>
<tr>
<th>Protein content of ration, percent</th>
<th>Average number eggs laid per hen</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>132</td>
</tr>
<tr>
<td>26</td>
<td>130</td>
</tr>
<tr>
<td>32</td>
<td>119</td>
</tr>
</tbody>
</table>

During this period the protein content of their diet had no effect on mortality rates.

Confined pullets gained slightly more weight than when allowed to range. Hens on range produced many more eggs than a comparable confined flock—137 per hen as compared to 107, respectively.

Pullets raised on range do not show symptoms of manganese deficiency during a complete laying year. There is no difference in production or in mortality between pens on Alaska-grown grains without additional manganese and those with additional manganese. Including manganese in the diet of laying hens and pullets did not affect their egg production or egg shell weights significantly. Alaska-grown grains apparently contain adequate supplies of manganese.
Fur Animals

Research in the breeding and feeding of fur animals is conducted at the Petersburg Fur Farm. Current feeding studies with ranch mink are focussed on finding a satisfactory substitute for whole salmon which is no longer available in sufficient quantities at prices low enough to serve as a staple ration. Increasing feed costs attributed to smaller fish harvests and greater human consumption have forced many fur farms out of business in recent years.

Feeding Ranch mink cannot be maintained in good health nor will they reproduce satisfactorily on a diet containing high percentages of red snapper (also called red cod). Red snapper is inferior to whole salmon, salmon canny waste, flounders or grey cod in the mink ration. Not more than 40 percent of red snapper can be included in a satisfactory mink diet. Halibut heads are another poor feed, especially for nursing fox females. Exceptionally high mortality rates in 1- to 3-month old fox pups were attributed to a high proportion of halibut heads in their mother's diet; many losses can be averted by replacing halibut heads with a combination of 10 percent horse meat and 40 percent red snapper when pups are 3 to 4 weeks old.

Late June, July and early August are critical months for young mink receiving high percentages of pink salmon waste in their diet; many succumb to “yellow fat” disease during this period. Heavy kit losses may be averted by replacing the salmon in their ration with other types of fish. A ration containing 80 percent frozen salmon waste was as good as 75 percent frozen whole salmon, and much superior to canned salmon waste or frozen ling cod as a feed for female mink during their gestation and suckling periods. Number of kits whelped per female ranged from 3.4 per litter for females on 80 percent frozen salmon waste to 2.4 per litter on ling cod. A ration containing 82 percent salmon waste without heads proved best during the mink's growing and furring out periods. Ling cod was again inferior, producing small weight gains and poor skins.

Blue and white fox appeared to reproduce better on a ration high in flounders than on a diet of half-and-half whole red snapper and salmon waste (5 pups per litter as compared to 3, respectively). A diet containing 45 percent halibut heads and 10 percent seal meal was better for fox pups during their growing and furring out periods than a ration containing 55 percent salmon waste and 10 percent seal meal.

Antibiotics Results of one experiment indicate that crude aureomycin supplement (APF-5) is beneficial to the production and growth of young ranch mink receiving rations containing high percentages of salmon waste.

Alpha-tocopheryl acetate at a level of 40 mgs. per pound of ration fed prevents “yellow-fat” disease normally experienced among young mink receiving rations high in salmon products. Pure aureomycin, added to mink rations containing high percentages of salmon waste, promotes better general health, and more rapid growth. All the rations were deficient, as evidenced by the high number of cotton pelts produced; aureomycin and alpha-tocopheryl were not beneficial in controlling this condition.
Breeding A program was started to determine the color and dominant characteristics of Arctic white, blue, and mutation blue fox. Because of the small number of fox available and because it is impossible to adhere to a prearranged breeding schedule, this program will no doubt take several years to complete.

In fox, white is recessive to blue; 10 to 20 percent whites are produced in the second generation of crossing these two color phases. The whites produced in this manner will breed true, and when mated together always produce 100 per cent white offspring. However, to date, all blues from litters containing any white animals have carried the white factor and produced a small percentage of white offspring when mated to animals of similar breeding. The mutation blue, characterized by a white blaze on its face, four white feet, small size and somewhat lighter pelt than the true blue fox, is also recessive to the blue. When this mutation is crossed with the white fox, the resulting offspring are blue in color and have a small, white blaze between their eyes and white tips on their toes. The second generation of such a cross vary in color from medium blue to white, and the whites carry the mutation factor.

One of the most interesting litters produced was from a brother and sister mating of first generation white and mutation blue crosses. There were 12 pups in this litter: 3 whites (at least one of which carried the mutation factor) 5 very light, milky blue, and 4 light blues. Two other litters, both white and mutation blue blood, contained several of these very light animals. These pelts are quite attractive and would bring good prices if it were not for the existing low market.

Two pairs of wild tundra mink were caught for breeding purposes during the summer of 1950. The wild tundra mink are very late breeders. Although the males are difficult to handle during the breeding season, limited experience indicates that this mink will produce well in captivity. In the mink program, only one of the wild tundra males bred in 1951. He mated one of the wild females and a hybrid pastel female. The other wild female was bred to a pastel male. The wild females each produced 5 kits (all females) and the hybrid pastel had 7 kits. This good production is contrary to that reported by breeders who have been trying to raise this type of mink in captivity the last year or two.

Continued attempts were made to obtain consistent production from marten raised in captivity. In 1950 nine females were bred—5 of which had no record of previous breeding. Only 2 litters totalling 7 kits were produced. In 1951 twelve marten were bred. The results of this breeding season will not be known until the spring of 1952.

ECONOMICS

Objectives of current agricultural economics studies are to analyze the relationship of production practices to the enterprise costs and returns from farming in Alaska and to provide information to farmers interested in improving their production practices. Present and potential markets for products of Alaska's farms are also under study, to the end that farm products may be fully utilized and that future production may be geared to the market needs of the period.
Farm Management and Production

Data gathered and analyzed in 1950 and 1951 emphasize that Alaskan agriculture is in a state of flux. Dairying still is increasing in the Matanuska Valley. In 1949, the net returns from potato farms averaged $5,669 and were $1,060 greater than the average for commercial dairies. In 1950, however, the position was reversed and dairy farms averaged a net income of $5,482 compared to $4,152 for potato farms. The improved status of dairymen occurred because of increased benefits from specialization and greater efficiency. The potato enterprise declined in over-all importance on potato farms and prices failed to rise proportionately to expenses in 1950. Poultry farm returns failed to rise with rising expenses in 1950. This largely accounts for the poorer showing of poultry farms in 1950 compared to those of 1949.

Changes in farming methods should result in lowered cost of farming and may be reflected in further changes over the next few years. Evidence of this is in the increased interest in silage and in efforts to maintain forage quality throughout the winter.

The current project in farm management accounts is the first attempt in Alaska at acquiring accurate data on costs and returns for various kinds of farms in the Territory. A series of enterprise analyses including methods of doing various jobs is being conducted to further aid in the study of better farm organization. The project must be continued for several years before variations in input-output factor relationships can be isolated from variations caused by weather and climatic conditions that cannot be controlled by man.

Marketing

This project is the only current work in the Territory which provides vital background marketing information from which new marketing alignments can be evolved. While no new principles have been developed, application of known principles to locate conditions has been valuable in orienting the size and characteristics of our local market to the potential supply of locally grown perishable products. Marketing research has been oriented to defining and describing potential markets for farm products of the Central Alaska area. Studies during 1950 centered on the Kenai Peninsula, its particular attributes and its market problems. This area was examined critically to determine its logical place in the agricultural economy of the Territory. All homesteaders and settlers on the Peninsula outside the settlements of Homer, Ninilchik, Kasilof and Kenai were interviewed concerning their present and future plans.

Two major reports were prepared. One, examining the potential market for a possible group settlement project was submitted to the Department of Interior-Department of Agriculture Committee on Group Settlement in Alaska as an aid in its deliberations. A second report, written in popular style, was prepared following a study of 127 rural settler families during the summer of 1950. In this report are portrayed the socio-economic conditions of settlers on the Kenai Peninsula, and their present conditions are keyed to the potential market for farm products from the area.
A study of the buying habits and weekly produce purchases of housewives in Anchorage and Fairbanks was conducted during the summer of 1951. Personal interviews were made with 89 housewives in Fairbanks and 200 in Anchorage and suburbs. A reporting form is being sent to the women each month to acquire a record of seasonal variations in volume and source of produce purchases. Some service work related to planning work of various governmental agencies was carried on during the year. Also, a survey of grocery costs in major Alaska cities was begun in late 1951 in response to many requests for information and need for retail price series in marketing research.

A trip was made to western Canada and Canadian marketing systems were studied. A 29-page dittoed report "Notes on Marketing Perishables From Fringe Areas of Western Canada, 1951" was prepared and limited distribution was made to specialists and individuals interested in the field of marketing. The report was not for general distribution. This project was designed to compare successful Canadian marketing methods in isolated areas with marketing methods and conditions in Alaska. It was dropped for lack of funds and the Alaska portion of the survey will not be made.

The Canadian portion of the study indicated that their farm marketing organizations in isolated communities generally follow some of the following practices:

1. They generally prefer that perishable vegetables be marketed by the individual grower.
2. They prefer to handle storables that need not move into consumption channels immediately.
3. They prefer to limit the number of varieties to a bare minimum.
4. They try to encourage uniform cultural practices.
5. They want the crop harvested when it is of market size and market quality.
6. They have adequate storage facilities on farms or at the warehouse.
7. They make producers responsible for grade.
8. They get the best managers available to run the business.
9. They pay wages sufficient to get and keep competent help.
10. They keep the help busy by shifting even the specialists throughout the organization during slack seasons. They do much of their repairing, remodeling, and storage of inventories with regular help recruited from other departments.
11. They keep their overhead and handling charges low.
The engineering research program was established in 1949, the nature of the experiments being such as to preclude early results. Thirteen experimental housing units were constructed at Palmer to test the usefulness of locally produced building materials and insulations; four types of ventilation units were installed in the poultry house at Matanuska; a combination drier was constructed at Fairbanks to dry cereals, forages, and small samples for plot studies and the hay drier at Matanuska was remodeled; a circular bin drier for drying cereals was installed at Matanuska. Some of these were in use during part of late 1950 and were ready for full use during the 1951 season.

Use of Native Materials

Under this project 2 related but different investigations were underway in 1951. One phase involves methods of utilizing local lumber in building farm structures suitable to Alaska. During the coming season data will be taken on power consumption, temperature, and resistance to air infiltration on 13 structures built with experimental wall sections of native material. Incomplete sampling of the data indicates that the use of vapor seal will save as much as 20 percent on the heat required as well as protect the structural members of a building. Spot checks of data also indicate that 5 of the 13 experimental buildings using native materials are equaling the performance of a standard unit which is constructed of finished imported materials.

A second door was added to all cabins in an effort to cut down the effect of air leakage around the outside doors. Sawdust used for a fill insulation in all floors and ceilings was found to decrease in moisture from 67 percent to below 20 percent in the first 9 months of operation.

Ventilation

Supplemental heat appears to be unnecessary in laying houses located in the Matanuska Valley when the houses are insulated, vapor sealed, and equipped with proper arrangements for ventilation. These conclusions are based on observations of 4 insulated and vapor sealed pens at the Matanuska Station. Two were heated and 2 were not. Egg production was not affected significantly.

Drying Wet Grain

Wet rainy weather in the fall causes much spoilage when grain is stored under normal methods. Use of 42 50-gallon bins for storage of barley at the Fairbanks Station was unsatisfactory. No heating occurred regardless of the moisture content when grain was stored. Larger bins were constructed and it is expected that results will be comparable to farm size storages. A column type batch drier is being used to provide information on grain drying problems and costs.
ENTOMOLOGY

An entomologist was added to the staff on March 2, 1950. The objectives of his investigations are to develop insect control measures that will be effective in facilitating crop, livestock and poultry production under Alaskan conditions; work out the biology of Alaskan insect species, continue list of Alaskan insects; conduct investigations in insect pollination of crop plants and biological control measures for injurious insects.

Root Maggot Studies

Chlordane, parathion, lindane, aldrin and dieldrin were the most promising of insecticides tested. Petrowski turnips were found to be slightly, but not significantly, more resistant to root maggot injury than white-fleshed varieties. Treatments with aldrin dieldrin, dilan and heptachlor gave excellent control of root maggots in white egg turnips. Furrow treatments of radishes with aldrin, heptachlor and dieldrin appeared promising in the Matanuska Valley. Several varieties of radishes, turnips and rutabagas were planted and checked for maggot resistance.

Maggot surveys indicated usual widespread activity from the Kenai Peninsula to the Yukon River in all areas checked. Near Homer a high degree of infestation was found in first plantings on newly cleared land. Onion maggots were again found in sets but not in green onions from seed over Alaska. Turnip and/or seed-corn maggot complex was found in all areas visited from Anchorage to Circle. Three species of wild mustard host plants were found.

Cutworm Investigations

In the Palmer area cutworm infestation was light in 1950. Value of soil treatments and baits was uncertain as no cutworms appeared in areas treated. Chlordane emulsion was very effective as a control measure in infestations of onions, peas and bromegrass plots. Tests in oat-bromegrass fields during 1950 in order of decreasing effectiveness were chlordane emulsion, parathion, aldrin, dieldrin, and chlordane wettable powder. Only a small percentage of the worms collected as larvae emerged as adults. In 1951 aldrin, chlordane and heptachlor were found to be especially effective in controlling cutworms when applied in emulsion form. The majority died from parasitism and disease. The 1951 infestation was more serious than 1950 in the Matanuska Valley. In the Tanana Valley the home gardens were seriously infested for the first time in several years and many people were forced to replant their gardens. Some injury occurred on the Kenai Peninsula.

Effect of Soil Treatment on Soil Biota

DDT, aldrin, dieldrin, parathion, chlordane, methoxychlor, and lindane mixed into the soil at a rate of 25 pounds to the acre had no effect in growth or maturity on radishes, turnips, oats or bromegrass. The fact that no maggot damage appeared in parathion-treated plots and little in lindane, aldrin or dieldrin plots offers an excellent lead in control possibilities. Heavy maggot infestation occurred in DDT, methoxychlor and check plots.
Wireworm Control

Barley is more susceptible to wireworm injury than either oats or wheat. In experiments at the Matanuska Experiment Station, lindane, dieldrin, aldrin, ethylene dibromide and chlordane gave good control of wireworms in grain. Wireworm damage in potatoes is apparently confined to limited though widely distributed localities in much of Alaska. Crop rotation or entire avoidance of infested fields for potatoes is probably the simplest and cheapest solution. In some areas of the Matanuska Valley seed pieces are invariably riddled while the tubers are only slightly damaged. Adult flight period for the Matanuska wireworm appears to be mid-June. Rearing attempts were unsuccessful.

HORTICULTURE

Potatoes currently are the major cash crop in Alaska. Other vegetables are of lesser but significant importance on many farms. Adapted fruits, berries and ornamentals are needed for the well-rounded farm program and for home beautification.

Potato Investigations

Varieties and New Lines Four Station selections have been developed for field trials among potato growers. These selections equal or exceed in yield any of the varieties now being grown and are far superior to them in smoothness, size and shape of tubers, freedom from skin feathering and, in some cases, in earliness of maturity.

Seedling 57.44-3-46* was increased from foundation stock in 1951. Approximately 50 bushels or 1.5 tons were available for further increase in 1952. Breeding lines of promising numbered selections and named varieties were continued.

Culture Consumer acceptance involves both a mealiness factor related to specific gravity and an independent blackening factor.

Specific gravities were found to decrease with increasing applications of nitrogen and potash though they increased with increasing applications of phosphate. The "blackening" factor was unrelated to fertilizer treatments although major differences were found between varieties. "Blackening" after cooking was not related to specific gravity or to mealiness.

An exploratory test on the Kenai Peninsula compared the effects of minor elements on potato yields. Iron, applied as ferrous sulfate at 100 pounds per acre decreased yields whereas calcium applied as ground limestone at 500 pounds per acre increased yields by highly significant amounts. Copper, boron, manganese, magnesium, cobalt and molybdenum had no effect on yields at this site.

• Since this report was first written, this selection has been introduced through the Alaska Certified Seed Growers Association as the variety "Knik".
Spacing and Fertilizers for 57.44-3-46 This variety should be planted at 9 to 11-inch spacing and fertilized (on Knik soil) at the rate of 60 pounds of nitrogen, 240 of phosphate and 120 of potash per acre. Thirteen inches is considered the maximum distance between seed pieces and 45-180-90 pounds of nitrogen, phosphate and potash respectively, the minimum acre fertilizer application for this variety.

Vinekilling Killing potato tops by flaming adversely affected the salability of tubers through stem end browning. No other treatment was injurious. Tubers from plots sprayed with Aero-Cyanate (18 pounds per acre) and from plots where tops were cut showed significantly lower specific gravity than tubers from check plots.

Chemical weed control Seven chemicals were used as sprays before potato sprout emergence and on the shoulder of the hill immediately after hilling. “Premerge” used as a pre-emergence spray at 10 quarts per acre gave excellent weed control with no apparent deleterious effects on yields or internal appearance of the tubers. Volunteer grains persisted but were pulled by hand; otherwise the soil was not cultivated or hoed. Chickweed failed to germinate after hilling on the rows sprayed with “Premerge” whereas it grew vigorously on untreated rows. The residual effects of “Premerge” persisted for 4 to 5 weeks in contrast to all other treatments where weeds were emerging 10 to 20 days after spraying.

Vegetable Testing, Breeding and Culture

Lettuce At least one U.S.D.A. strain of lettuce (No. 3310*) is superior to any of the present day commercial varieties in yields, size, type of head and freedom from premature seed stalk formation. Lettuce growers in the Matanuska Valley have asked for its introduction as a named variety and the matter is now under consideration. In view of the importance of lettuce production in Alaska this finding, if verified by further tests, should prove of great value to both growers and the consuming public in the Territory.

There were great differences among 25 varieties and strains of lettuce tested in such characteristics as size and shape of head, degree and location of tipburn, density, and number of marketable heads produced. Some of the varieties, such as Progress, which are said to be well adapted to certain regions of the States, appear to be worthless under Alaskan conditions. On the other hand, U.S. D. A. strain Nos. 3310*, 3867, and 2451 which have not been found especially well adapted to culture in the States seem to be well adapted here. Of 12 commercial varieties and 3 numbered, unnamed selections as judged by total weight of marketable heads produced: Cornell No. 458, No. 3310, No. 4164, Premier Great Lakes, Great Lakes No. 659, No. 4183, Great Lakes No. 428, Pennlake and Great Lakes No. 407 were acceptable; Progress, Imperial 44, Imperial No. 152, New York Supreme No. 55, New York No. 515, and Improved No. 615 (101) were not adapted. In general, freedom from early bolting coincided with high yielding ability.

* Since this report was written this selection has been released to commercial growers as the variety “Alaska”.
Cabbage A systematic test of 20 varieties of cabbage was conducted at the Matanuska Station during 1951. The relative merit of these varieties as determined by yielding ability was: Bugner C-1, Wisconsin Ballhead, Jaatun, Ferry's Hollander, Seidl Ballhead, Bonanza, Globe, All head Select, Marion Market, Glory of Enkhuizen, Resistant Detroit, Early Cortland, Early Jersey Wakefield, Golden Acre, Gruner Edelstein, Wunderkopff, O-S Cross, Hybrid Cabbage, Langendijker and Winterfurst. The last 6 varieties in the list proved to be too late maturing for this region, but among the 14 that produce marketable heads some appeared to be superior to the varieties now commonly grown in the Matanuska Valley.

Other Vegetables Crosses of 5 varieties of broccoli were made at the Matanuska Station with the objective of creating an early maturing, better adapted variety for culture in Alaska. Of 7 named varieties tested, Waltham No. 29, Texas No. 107 and Morse's Early were the most desirable in that order.

A wide range of vegetable varieties and strains were tested at the Fairbanks Station for possible adaptability to the climate and soils of the Tanana Valley. These tests included 287 varieties and strains of vegetables representing 41 species of plants, as follows: beans 21, beets 18, carrots 36, Chinese cabbage 2, sweet corn 8, cucumbers 2, herbs 9, kohlrabi 2, lettuce 9, parsnips 12, parsley 2, peas 25, radish 18, rutabaga 9, spinach 5, tomatoes 14, and 17 miscellaneous vegetables.

Also under test were 302 varieties and strains of beans representing a part of the "Shoemaker-Tracy" collection and native beans secured from various Indian tribes living in the high altitude sections of the southwest United States. The majority of these beans did not mature but 79 varieties were saved for further testing.

Transplanting Transplanted plants of Golden Acre, Midseason Market and Oakview Ballhead cabbage produced a crop ranging from 50 to 80 percent of marketable heads. Seed sowed directly in the field produced less than 20 percent marketable heads. Oakview Ballhead (a late variety) produced less than 5 percent marketable heads when seeded directly.

Vegetable Forcing At the Matanuska Experiment Station all forcing stocks of rhubarb 2 years old or older were lifted and divided for increase in 1951 and 4 varieties (Sunrise, Kusnachter, Red Delicatesse and Cyklop) were added to those under test. At the Fairbanks Experiment Station the varieties Linnaeus, Victoria and Sunrise were added to the collection of rhubarb varieties under test and all stocks on hand were lifted and divided to increase the number of plants.

Ornamentals

Since nursery stock is always injured more or less in shipment and sometimes also shows evidence of having been injured in the nursery, it is questionable whether hardiness tests based on the use of imported nursery plants actually test the inherent hardiness of a given species or merely test its relative freedom from previous injury. Partially to overcome this difficulty and to secure a greater variety of materials for testing, 45 species of trees and 70 species of shrubs were propagated by seed in nursery beds. Certain species require spring seeding and good stands were secured with these in practically
all cases. The remainder were fall seeded. Of the 70 species of
trees and shrubs planted as seed in 1950, 58 species germinated in 1951
and 17 made sufficient growth to warrant transplanting them into
the open ground.

Other plantings of perennial ornamentals at the Matanuska
Station during the past year included the following: day Lilies (7),
miscellaneous Lilies (8), iris (7), peonies (7), phlox (10), and gladioli
(25). A planting of annual flowers consisting of 94 varieties, represent-
ing 19 species was made at the Matanuska Station during 1950.
Twelve varieties of chrysanthemums also were set out, but the plants
arrived in very poor condition and only a few of them survived.

A considerable number of both native and introduced ornament-
als was assembled at the Fairbanks Station during the year. Included
were 8 species of trees, 16 species of shrubs and 23 species of her-
baceous perennials. Plantings of annual flowers in 1951 consisted
of 69 varieties representing 17 species. The following developed
satisfactorily: argeratum (1), antirrhinum (9), asters (3), calendula
(1), annual chrysanthemums (2), cosmos (7), lobelia (3), marigolds
(7), nasturtiums (6), nemesia (1), pansies (9), petunias (8), phlox
(2), schizanthus (1), sunflowers (2), stocks (3), and zinnias (4).

Fruit Investigations

Tree Fruit Variety Testing and Culture From present indications
it appears possible that certain tree fruits, such as crab apples,
certain species of cherries, some of the cherry-plum hybrids and
perhaps *Prunus tomentosa* may yet prove hardy in the Matanuska
Valley under suitable methods of culture. Of the original 131
varieties planted, 96 were still represented by living trees and of
the trees set 50 percent were still living. Many trees still living are
in a very weakened condition and are not expected to survive. The
following varieties or species all made good growth and appear
thrifty: Apples; Red Duchess, Erickson, Dwarf Yellow Transparent
and Victory. Crab apples; Transcendent, Golden Anniversary, Trial,
and Dolgo. Cherries; Compass, Dakota Amber, Korean No. 57, Hansen's Super Bush, and Western Chokecherry. Plum; Minnesota No.
101. Apricot; Scout.

The variety test, planted at the Matanuska Station, was in-
creased by 5 varieties of crab apples (Adam, Osman, Red Siberian,
Rescue, and Sylvia), 3 standard apple varieties (Renown, Reward and
Heyer No. 12), 2 plums (Dropmore Blue and Mandarin) and 1 cherry
(Mongolian). The entire planting was pruned, fertilized and culti-
vated. Tree fruit plantings at the Fairbanks Station during 1951
included 4 varieties of standard apples (Reward, Bayer No. 3, Heyer
No. 12, and Renown); 5 varieties of crab apples (Adam, Osman, Red
Siberian, Rescue, and Sylvia) and 1 cherry variety (Mongolian).

Small Fruit Variety Testing and Culture A collection was made
in 1949 of all available hardy stocks of strawberries of which the
greater part are believed to be "Sitka Hybrids". These will be
used in future breeding programs here and have already been shared
with Stateside strawberry breeders. Present-day commercial varieties
unmulched were not hardy at the Matanuska Station whereas some
of the Sitka Hybrids survived under the same condition and developed
normal runner plants. The fall and winter of 1950-1951 was ex-
tremely hard on all types of small fruits in the Matanuska Valley
and many growers lost their entire plantings. In the strawberry
test at the Matanuska Experimental Station not a single plant of the 28 commercial varieties survived. However, 10 of the native or Sitka Hybrid varieties survived and these were transferred to a more favorable location for propagation. Consequently it is possible to advise prospective strawberry growers that the Sitka Hybrids are the better investment at the present time.

Test plantings of small fruits at the Matanuska Station during 1950 included 32 varieties of strawberries, 24 varieties of raspberries, 9 varieties of currants, and 8 varieties of gooseberries. There was considerable killing in practically all types of small fruits during the winter but surviving plants made unusually good growth during the summer.

Raspberries also showed severe winter injury in 1950-51 and 7 varieties were killed. Of the 17 surviving varieties Sunbeam, Chief, Latham, St. Regis, Washington, Ruddy and Durham Everbearing showed evidence of possessing considerable winter hardiness. Practically all currant varieties showed winter injury but of the commercial varieties only Cascade, Red Cross and Grape currant were killed. Of 8 gooseberry varieties Carrie, Houghton, and Josselyn were killed while those surviving showed severe winter injury.

Test plantings of small fruits at the Fairbanks Station during 1951 included 10 varieties of currants, 4 varieties of gooseberries and 12 varieties of raspberries. A strawberry nursery was started from plants collected from old strawberry beds in and around Fairbanks and selected plants from an old strawberry bed at the Experiment Station. A seedling nursery was also planted from seed collected the previous year. Great variation as to plant type, leaf characteristics and runner habit were noted in this seedling stock. The nursery will be expanded next year by further collections of hardy plants and seed throughout the Tanana Valley to initiate a strawberry breeding program.

At the Fairbanks Station a planting of 368 blueberry selections was renovated in the summer of 1950. This planting was made originally by Dr. J. P. Anderson in 1931 and consists of selections from native plants throughout the Territory. Hardwood and softwood cuttings were made from selected plants as a means of increasing stocks of the more desirable types.

**Greenhouse Production**

Soils in the Matanuska Valley are not well adapted for greenhouse use because their fine texture and general lack of structure causes them to pack badly when used in seed flats or greenhouse benches. Under such conditions seeds germinate poorly and the growth of young seedlings is seriously stunted.

An experiment to determine whether the soil can be improved by the addition of varying proportions of sand and such other soil conditioners as peat, manure, muck or vermiculite indicates that: (1) Emergence of both celery and cauliflower was poorest on soil alone. (2) A soil mixture containing 20, 30 or 50 percent sand gave the most satisfactory emergence with both crops. (3) The use of commercial fertilizer reduced germination of seed of both crops. (4) Seedling growth was most satisfactory for both crops on soil containing 40 percent sand plus 20 percent of any one of the 4 soil conditioners.
PLANT PATHOLOGY

The addition of a station pathologist on March 10, 1951 made possible study of certain problems limiting work in the various agronomic and horticultural crop being studied.

During his first season the pathologist started a systematic collection and identification of plant diseases leading to the establishment of a permanent herbarium. Trials were started on the chemical control of lettuce anthracnose. Bacterial wilt in yellow flowered alfalfa (*Medicago falcata*) was discovered for the first time in Alaska. Better understanding of the incidence and losses caused by ring rot of potatoes was obtained. Examination of existing potato seed stocks showed that none could be presumed free from ring rot. The Matanuska Station has adopted a tuber unit procedure to assure the potato growers that disease-free stocks can be maintained in Alaska.

SOIL SCIENCE

Current soil research involves classification and inventorying soil resources, developing or adapting rapid analytical techniques for soil testing, investigating fundamental physical and chemical characteristics of Alaskan soils and measuring the response of crops to fertilizer amendments.

Soils

**Soil Classification and Mapping** Work in the Matanuska Valley during the biennium has revealed that important agricultural enterprises are chiefly supported by 2 mineral soil series called Knik and Bodenburg. Successful farms are supported by deep phases of these soils. Shallow phases now support only part-time enterprises. Because of drainage problems, organic soils remain marginal in character. Drainage problems are acute to the extent of eliminating the use of organic soils until local demands make their exploitation economically feasible.

In any estimate of agricultural potential, climate must receive as much consideration as soil characteristics. Limited meteorological studies of the Susitna Basin show the growing season in this area to be relatively short—somewhere within the range of 78 to 90 days. Rainfall is somewhat greater than in the Matanuska region. Comparable climates elsewhere in the world have never supported much more than a bare subsistence for farm populations. Agricultural development of the Susitna Basin under existing economic conditions is therefore unlikely. The limiting factor in the development of this region is anticipated to be deficiencies in climate rather than in soils although areas of good soils are widely scattered.

**Soil Testing** Some 1,520 samples were processed representing 33 areas widely distributed throughout the Territory. Included were samples received from 223 cooperators, to whom all results were returned with interpretive recommendations. Some 516 samples were analyzed only for soil reaction, nitrates, phosphates, and potash;
in addition to these four characteristics, 757 samples were analyzed for calcium, iron, magnesium, manganese, aluminum, copper and ammonia content.

As in former years, attempts at correlating plant responses and soil nutrient levels revealed by rapid analysis on random samples proved disappointing. Although some relation between soil phosphate levels and plot yields was observed, no significant correlation existed between actual yields and measured nitrogen or potash levels. Despite this lack of correlation between nutrient levels as determined by chemical procedures and measured yields, field observations during the growing season indicate that the analytical procedures should not be discarded as worthless. Experience elsewhere shows that many factors other than soil nutrient levels influence plant growth. Here in Alaska, soil temperatures and light conditions certainly exert a profound effect on plant nutrition. It is therefore naive to expect a high degree of relationship between crop responses and any single growth factor. Another fallacy underlying interpretations of soil tests is the sampling technique which may introduce so strong a bias as to obscure the interactions in question. On the whole agricultural producers and action agencies display a high degree of confidence in the test results.

General conclusions resulting from soil testing in the Matanuska Valley are:

1. Dark-colored soils are relatively high in potash while light-colored soils are low in potash.

2. Samples selected from undisturbed sites representing potential plow layers are generally more acid than comparable fields under cultivation. This difference is attributed to organic matter characteristics and associated microbiological activities.

3. As the pH rises during cultivation, nutrient levels decrease.

4. Old garden soils are generally characterized by high nitrogen levels, probably a result of intensive management practices.

5. The inherent fertility of most agricultural soils is not high, a common attribute of soils developed under humid conditions.

6. Nitrogen and phosphate fertilizers are essential for efficient production.

Fertilizers

In certain western states, pot-testing techniques have yielded better prediction information than rapid chemical tests. Pot-testing techniques may prove useful in Alaska. Three levels of phosphate (50, 100, 200 pounds) and 4 levels of potash were major treatments applied on a Bodenburg silt loam sample. Each phosphate increment gave a highly significant yield increase and significantly decreased the percentage of water in the foliage. Potash increments could not be related to yields or moisture content. Manganese, iron, and boron applied at the rates of 200, 100, and 25 pounds per acre
respectively superimposed on a uniform treatment including nitrogen, phosphate and potash did not increase the productivity of Bodenburg silt loam as measured by the response of lettuce.

**Chemical and Physical Properties** Organic matter studies of 2 soil series from the Tanana Valley revealed a maximum of 49 percent (of oven-dry weight) in the A30 horizon to a minimum of 2 percent at a depth of 24 inches in the subsoil. Distribution within the profile resembled that of podzolized soils. In adjacent cultivated fields the organic matter content varied from 8 to 10 percent in the plow layer.

The average organic content of a postulated plow layer from a wooded site in the Chatanika series was 41 percent as compared to 10.4 percent in an adjacent well-managed cultivated field under production for at least 15 years. A neighboring newly broken field contained an average of only 4.6 percent organic matter.

Comparisons of some 40 samples from cultivated fields in the Matanuska-Chugiak-Anchorage area disclosed no significant differences in organic matter content between "light-colored" and "dark-colored" categories. The so-called "dark-colored" soils (Knik and Bodenburg series) in the Matanuska Valley are apparently dark because of their dark colored mineral constituents.

**Field Moisture** Transmission of moisture from subsoil to surface in Bodenburg fine sandy loam was not sufficiently rapid to insure satisfactory germination or early growth of such shallow planted crops as carrots and onions. This soil, which lacks structural development, is extremely susceptible to rapid surface drying and wind erosion. Sprinkler irrigation decreased surface drying and the wind erosion by firming the seedbed. Germination and early growth was encouraged.

Although an adequate moisture supply was present in the subsoil, it was unavailable to shallow-rooted crops because it did not move upward in response to tension differentials. Moisture movement can be increased within the plow layer by packing immediately before or after seeding, by sprinkling or by increasing the organic content and thereby promoting structural development.

**Manganese for Oats** Application of 50 to 100 pounds per acre of manganese sulfate (80%) either reduced or controlled foliar deficiency symptoms commonly exhibited by Climax oats in the Matanuska Valley. Manganese applications increased both oat grain and hay yields. Increases in grain yields varied from 10 to 30 bushels per acre; at current prices, $3 worth of manganese fertilizer increased returns per acre from $20 to $60. Hay yields were likewise increased by manganese treatments. The magnitude of these increases is indicated by yields ranging from 16 bushels per acre (2.6 tons of dry hay), where no fertilizer was applied to a maximum of 89 bushels per acre (3.9 tons of hay) from plots receiving 100 pounds of manganese sulfate, 50 pounds of available nitrogen, 80 pounds of available phosphate and 40 pounds of potash per acre.
Large economical yield increases were obtained from nitrogen applications of 30 to 50 pounds per acre. Phosphate (at the rate of 80 pounds per acre of P₂O₅) also increased yields, especially when applied with nitrogen and potash. Potash did not increase yields, either when applied alone or in combination with nitrogen, phosphate and manganese. Heavy nitrogen applications resulted in severe lodging, an effect that was counteracted by phosphate. Grain yields were increased more than forage yields by nitrogen fertilizers. Nitrogen and phosphate together, but without manganese, effectively decreased "gray speck" symptoms.

Manganese sulfate applied to oats, barley, wheat and rye did not increase either grain or straw yields nor did it improve grain quality.

**Minor Elements** Head lettuce, onions, and carrots failed to respond to boron and manganese treatments. No minor element plot appeared superior to untreated plots. On the contrary, addition of minor elements seemed to cause early growth retardation and marginal foliar yellowing on all crops but onions.

**INDEX TO ALASKA WORK AND LINE PROJECTS**

The following list shows a departmental breakdown of line projects and also shows the staff responsibilities for general supervision of each work project. Initials after the index number indicates which fund is used for the major support of each project, according to the following code:

(A) Adams  
(P) Purnell  
(T) Territorial  
(H) Hatch  
(F) Federal  
(R) Research and marketing  
(BJ) Bankhead-Jones

**AL-1-1** Soil classification, mapping, and management — A. H. Mick

1(F) Soil Classification and mapping in the Matanuska Valley  
2(F) Soil classification and mapping in the Tanana Valley  
3(F) Soil classification and mapping elsewhere in Alaska  
4(H) Soil fertility levels as indicated by rapid soil analysis  
5(F) Fundamental chemical characteristics of Alaskan soils  
6(F) Fundamental physical characteristics of Alaskan soils  
7(F) Fertilizers for small grains  
8(F) Fertilizers for forage crops  
9(F) Response of oats to manganese  
10(T) Minor elements  
11(F) Soil fertility levels as indicated by pot-testing techniques

**AL-1-2** Horticultural crop investigations — — M. F. Babb  
4(R) Potato breeding  
7(P) Potato culture and storage investigations  
8(T) Vegetable culture, storage and processing investigations  
9(F) Vegetable forcing investigations  
10(F) Variety testing and culture of ornamentals  
11(F) Tree fruit variety testing and culture  
12(F) Small fruit variety testing and culture  
13(F) Vegetable and flower production in greenhouses  
14(F) Vegetable variety testing and breeding
AL-1-3 Animal and dairy production .............................................. W. J. Sweetman
1(H) Raising dairy calves
2(F) The value of light for increasing milk production
3(R) Dairy cattle breeding investigations
5(F) Effect of the addition of artificial light on egg production and physical condition of laying hens
6(T) Sea fish and sea mammals and products as foods for fur animals
7(T) Cross-breeding of various fur animals
8(F) Effect of the “Free-Choice” feeding of chickens on growth and egg production under Alaskan environmental conditions
9(F) The effect of . . . manganese in the diets of hens and pullets
10(F) Production costs of . . . (raising) . . . dairy steers

AL-1-4 Agricultural engineering ................................................. C. I. Branton
1(F) Investigations to . . . (improve storage of) . . . white potatoes
3(BJ) Insulation and ventilation requirements of farm structures
4(F) Handling and storing high moisture content cereal grain

AL-1-5 Agricultural economics .................................................... H. A. Johnson
1(F) Study of farm management and production problems in middle Alaska
2(R) Markets for Alaska’s agricultural products
3(R) Marketing problems of isolated agricultural communities

AL-1-6 Field crops investigations .............................................. H. J. Hodgson
1(A) Alfalfa breeding—foundation seed production
2(F) Bromegrass breeding—foundation seed production
3(F) Cereal crop breeding
4(T) Adaptation studies on introduced grasses and legumes
5(F) Cereal crop culture
6(F) Pasture and range improvement and management
7(P) Feed production, processing, and preservation
8(F) Mixtures of grasses and legumes
9(F) Weed control
10(R) Evaluate . . . cereal crops for adaptation to subarctic conditions
11(A) Forage crop breeding
12(P) Forage crop production

AL-1-7 Entomological investigations ........................................... R. H. Washburn
1(A) Root maggots
2(F) Cutworm investigations
3(F) Effect of soil treatments on soil biota and future plant growth
5(F) Wireworm investigations

AL-1-8 Plant pathology investigations ....................................... D. M. Coe
1(P) Survey of economic crop diseases
2(P) The use of fungicides for the control of plant diseases
3(P) Pathology of winterkilling of forage crops
PUBLICATIONS

Bulletins
Moore, C. A., Farming in the Matanuska and Tanana valleys of Alaska, Bulletin 14 (now at the printers)

Circulars
Coe, D. M., Tuber units for better seed potatoes, Mimeographed Circular 2
Hodgson, H. J., S. C. Litzenberger, B. M. Bensin, & J. E. Osguthorpe, Recommended varieties of field crops for Alaska, Circular 14
Litzenberger, S. C. & B. M. Bensin, Golden Rain oats for Alaska, Circular 15
Litzenberger, S. C. & B. M., Bensin, Edda barley for Alaska, Circular 16
Moore, C. A. Alaska Farms: Organization and practices in 1949, mimeographed Circular 1

Journal Articles
Litzenberger, S. C., Reaction of cereal varieties to smuts in Alaska, The Plant Disease Reporter 35:482-484 1951
Irwin, D. L., Science in Alaska's agriculture, Science November 1951
Johnson, H. A., The role of agricultural economics in Alaska, 2nd Alaska Science Conference, AAAS, September 1951
Mick, A. H., Soil research in Alaska, 2nd Alaska Science Conference, AAAS, September 1951
Sweetman, W. J., Livestock in Alaska, 2nd Alaska Science Conference, AAAS, September 1951
Sweetman, W. J., Artificial Breeding in Alaska and the Effect of Extra Light During the Short Winter Days, American Dairy Science Meeting Ithaca, N. Y. 1950

Interim Report
Johnson, H. A., Marketing perishables from fringe areas of western Canada, (processed) November 1951

Popular Articles
Coe, D. M., Potato storage, The Alaskan Agriculturist (submitted)
Litzenberger, S. C., Golden Rain oats for Alaska, The Alaskan Agriculturist

Annual Reports
12th Annual Progress Report, 1947 (printed)
13th Annual Progress Report, 1948 (printed)
14th Annual Progress Report, 1949 (printed)
15th Annual Progress Report, 1950 (dittoed preliminary)
16th Annual Progress Report, 1951 (dittoed preliminary)
## FINANCIAL REPORT

Listed below are receipts and expenditures of the Alaska Agricultural Experiment Station under Federal and Territorial appropriations for the fiscal years 1949-50 and 1950-51.

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<thead>
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<th>Source and use</th>
<th>1949-50</th>
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<tr>
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<tr>
<td>Building fund</td>
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<tr>
<td>Sales</td>
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### RECEPTS

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<tr>
<th>Adams</th>
<th>Bankhead-Jones</th>
<th>Hatch</th>
<th>Purnell</th>
<th>Research marketing</th>
<th>Direct**</th>
<th>TERRITORY</th>
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<td><strong>FEDERAL</strong></td>
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### EXPENDITURES

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<th>Adams</th>
<th>Bankhead-Jones</th>
<th>Hatch</th>
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### RECEIPTS

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<td>Treasury of the U. S.</td>
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### EXPENDITURES

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**As per appropriations for the fiscal year reported**

**For Research on the Agricultural Problems of Alaska**